California Environmental Protection Agency

Air Resources Board

PERMEATION RATES OF SMALL OFF ROAD ENGINE HIGH - DENSITY POLYETHYLENE FUEL TANKS (APRIL 2001 TESTING)

Engineering and Certification Branch Monitoring and Laboratory Division

June 8, 2001

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Introduction

The California Air Resources Board (CARB) staff tested twelve High-Density Polyethylene (HDPE) fuel tanks to determine their permeation rates. Tanks were preconditioned with commercial fuel, refilled with Phase II California Reformulated Certification (CERT) fuel, and subjected to a variable temperature profile. Permeation rates were then determined gravimetrically during the month of April.

Test Protocol

In February and March the untreated tanks used with 4-cycle engines underwent the preconditioning process using commercial fuel, per CARB Test Method 513. Untreated tanks used with 2-cycle engines underwent the preconditioning process using a 2% commercial fuel/oil mixture. The tanks were stored at ambient temperature and pressure in flameproof storage cabinets. After at least four weeks of ambient preconditioning, the tanks were emptied; dried with compressed zero air, and immediately refilled with either CERT fuel or a 2% CERT fuel mixture. The tanks were then sealed using a hand held fusion welder and 1/4" thick HDPE coupons and leak tested as specified in Test Method 513 (a copy can be found at the CARB web site: http://www.arb.ca.gov/regact/spillcon/spillcon.htm).

Weight loss was used to determine relative permeation rates. Sealed tanks were weighed using a 16,000 gram or 6,200 gram balances with sensitivities of ± 0.1 and ± 0.01 grams respectively. After each tank was weighed, the weight was recorded. They were then placed in the Sealed Housing for Evaporative Determination (SHED) and exposed to a 1-day/24-hour/1440-minute variable temperature profile (see Attachment 1). This profile is considered our diurnal cycle (recurring every day). Tanks were then post weighed after each 24-hour diurnal cycle and the weight loss calculated.

Results

Cumulative weight losses were determined for each container as a function of time. The tanks underwent multiple diurnal cycles, but results are calculated using only the last five 24 hour cycles. The initial days of test data were not used in determining individual per container permeation rates due to high variability. A summary of all test results can be found in Attachment 2.

The average permeation rate from the 3.9 gallon Toro tank (72045) designated T6 was determined to be 0.77grams/gallon/day. This rate is based on data averaged from tests of five 24-hour diurnal cycles.

The average permeation rate from the 7.5 gallon Toro tank (3100) designated T8 was determined to be 0.35 grams/gallon/day. This rate is based on data averaged from tests of five 24-hour diurnal cycles.

The average permeation rate from the 0.16 gallon 2-cycle Echo leaf blower tank (PB-231) designated T15 was determined to be 1.88 grams/gallon/day. This rate is based on data averaged from tests of five 24-hour diurnal cycles.

The average permeation rate from the 0.25 gallon Briggs & Stratton tank (695106) designated T24A was determined to be 5.56 grams/gallon/day. This rate is based on data averaged from tests of five 24-hour diurnal cycles.

The average permeation rate from the 0.25 gallon Briggs & Stratton tank (695106) designated T24B was determined to be 5.17 grams/gallon/day. This rate is based on data averaged from tests of five 24-hour diurnal cycles.

The average permeation rate from the 0.15 gallon 2-cycle Echo string trimmer tank (SRM-261) designated T26 was determined to be 3.09 grams/gallon/day. This rate is based on data averaged from tests of five 24-hour diurnal cycles.

The average permeation rate from the 1.75 gallon Toro tank (71197) designated T28 was determined to be 1.05 grams/gallon/day. This rate is based on data averaged from tests of five 24-hour diurnal cycles.

The average permeation rate from the 2-cycle Frigidare Home Products tank (530-049393) designated T33 was determined to be 2.74 grams/gallon/day. This rate is based on data averaged from tests of five 24-hour diurnal cycles.

The average permeation rate from the 2-cycle Frigidare Home Products tank (530-038592) designated T34 was determined to be 2.94 grams/gallon/day. This rate is based on data averaged from tests of five 24-hour diurnal cycles.

The average permeation rate from the 2-cycle Frigidare Home Products tank (530-049318) designated T35 was determined to be 2.08 grams/gallon/day. This rate is based on data averaged from tests of five 24-hour diurnal cycles.

The average permeation rate from the 2-cycle Frigidare Home Products tank (530-052343) designated T36 was determined to be 3.00 grams/gallon/day. This rate is based on data averaged from tests of five 24-hour diurnal cycles.

The average permeation rate from the 0.25 gallon Tecumseh tank (11A-021C000) designated T40 was determined to be 2.74 grams/gallon/day. This rate is based on data averaged from tests of five 24-hour diurnal cycles.

The average permeation rate from the 0.25 gallon Briggs & Stratton tank (12A-559K401) designated T41 was determined to be 4.08 grams/gallon/day. This rate is based on data averaged from tests of five 24-hour diurnal cycles.

The average permeation rate from the 0.38 gallon 2-cycle Stihl leaf blower tank (BR-340) designated T45 was determine1d to be 0.21 grams/gallon/day. This rate is based on data averaged from tests of five 24-hour diurnal cycles.

Attachment 1

1 Day / 24 Hour / 1440 Minute Variable Temperature Profile

HOUR	MINUTE	TIME REMAINING (MINUTES)	TEMPERATURE (°F)
0	0	1440	65.0
1	60	1380	66.6
2	120	1320	72.6
3	180	1260	80.3
4	240	1200	86.1
5	300	1140	90.6
6	360	1080	94.6
7	420	1020	98.1
8	480	960	101.2
9	540	900	103.4
10	600	840	104.9
11	660	780	105.0
12	720	720	104.2
13	780	660	101.1
14	840	600	95.3
15	900	540	88.8
16	960	480	84.4
17	1020	420	80.8
18	1080	360	77.8
19	1140	300	75.3
20	1200	240	72.0
21	1260	180	70.0
22	1320	120	68.2
23	1380	60	66.5
24	1440	0	65.0

Attachment 2

PERMEATION TEST RESULTS

April 2001

Diurnal Cycles	Tank		Tank	Treatment	Test	Fuel	Avg. Loss
(# 24 hr cycles)	Label	Mfg.	Volume	Level	Dates	Type	(g/gal/day)
5	T6	Toro	3.9 gal	Untreated	3/30 - 4/11	CERT	0.77
5	T8	Toro	7.5 gal	Untreated	3/30 - 4/11	CERT	0.35
5	T15	Echo	0.16 gal	Untreated	3/30 - 4/11	CERT Mix	1.88
5	T24A	Briggs	0.25 gal	Untreated	3/30 - 4/11	CERT	5.56
5	T24B	Briggs	0.25 gal	Untreated	3/30 - 4/11	CERT	5.17
5	T26	Echo	0.15 gal	Untreated	3/30 - 4/11	CERT Mix	3.09
5	T33	FHP		Untreated	3/30 - 4/11	CERT Mix	2.74
5	T34	FHP		Untreated	3/30 - 4/11	CERT Mix	2.94
5	T35	FHP		Untreated	3/30 - 4/11	CERT Mix	2.08
5	T36	FHP		Untreated	3/30 - 4/11	CERT Mix	3.00
5	T40	Tecumseh	0.25 gal	Untreated	3/30 - 4/11	CERT	2.74
5	T41	Briggs	0.25 gal	Untreated	3/30 - 4/11	CERT	4.08
5	T45	Stihl	0.38 gal	Untreated	3/30 - 4/11	CERT Mix	0.21
						Average	2.66

Attachment 2

Label	Т6				
Tare	1705		Fuel Densi	ty	2791 grams/gallon
_					
Day	Wi grams	•	Change	Permeation	
D1	11093.8	11091.9	1.9	0.56	
D2	11091.9	11089.7	2.2	0.65	
D3	11089.7	11087.8	1.9	0.57	
D4	11087.8	11085.6	2.2	0.65	_
D5	11085.6	11083.0	2.6	0.77	
D6	11083.0	11080.7	2.3	0.68	
D7	11080.7	11078.0	2.7	0.80	
D8	11078.0	11075.4	2.6	0.77	
D9	11075.4	11072.7	2.7	0.80	
			Avg.	0.77	
Label	T8				
Label Tare	T8 3886.4		Fuel Densi	ty	2791 grams/gallon
Tare	3886.4	147		•	2791 grams/gallon
Tare Day	3886.4 Wi grams	•	Change	Permeation	2791 grams/gallon
Tare Day D1	3886.4 Wi grams 15963.1	15962.6	Change 0.5	Permeation 0.12	2791 grams/gallon
Tare Day D1 D2	3886.4 Wi grams 15963.1 15962.6	15962.6 15961.5	Change 0.5 1.1	Permeation 0.12 0.25	2791 grams/gallon
Tare Day D1 D2 D3	3886.4 Wi grams 15963.1 15962.6 15961.5	15962.6 15961.5 15961.7	Change 0.5 1.1 -0.2	Permeation 0.12 0.25 -0.05	2791 grams/gallon
Tare Day D1 D2 D3 D4	3886.4 Wi grams 15963.1 15962.6	15962.6 15961.5	Change 0.5 1.1 -0.2 1.2	Permeation 0.12 0.25 -0.05 0.28	2791 grams/gallon
Tare Day D1 D2 D3	3886.4 Wi grams 15963.1 15962.6 15961.5	15962.6 15961.5 15961.7	Change 0.5 1.1 -0.2	Permeation 0.12 0.25 -0.05	2791 grams/gallon
Tare Day D1 D2 D3 D4	3886.4 Wi grams 15963.1 15962.6 15961.5 15961.7	15962.6 15961.5 15961.7 15960.5	Change 0.5 1.1 -0.2 1.2	Permeation 0.12 0.25 -0.05 0.28	2791 grams/gallon
Day D1 D2 D3 D4 D5	3886.4 Wi grams 15963.1 15962.6 15961.5 15961.7 15960.5	15962.6 15961.5 15961.7 15960.5 15958.7	Change 0.5 1.1 -0.2 1.2	Permeation 0.12 0.25 -0.05 0.28 0.42	2791 grams/gallon
Day D1 D2 D3 D4 D5 D6	3886.4 Wi grams 15963.1 15962.6 15961.5 15960.5 15958.7	15962.6 15961.5 15961.7 15960.5 15958.7 15957.4 15956.0	Change 0.5 1.1 -0.2 1.2 1.8 1.3	Permeation 0.12 0.25 -0.05 0.28 0.42 0.30	2791 grams/gallon
Day D1 D2 D3 D4 D5 D6 D7	3886.4 Wi grams 15963.1 15962.6 15961.5 15960.5 15958.7 15957.4	15962.6 15961.5 15961.7 15960.5 15958.7 15957.4 15956.0	Change 0.5 1.1 -0.2 1.2 1.8 1.3 1.4	Permeation 0.12 0.25 -0.05 0.28 0.42 0.30 0.32	2791 grams/gallon
Day D1 D2 D3 D4 D5 D6 D7 D8	3886.4 Wi grams 15963.1 15962.6 15961.5 15960.5 15958.7 15957.4 15956.0	15962.6 15961.5 15961.7 15960.5 15958.7 15957.4 15956.0 15954.5	Change 0.5 1.1 -0.2 1.2 1.8 1.3 1.4 1.5	Permeation 0.12 0.25 -0.05 0.28 0.42 0.30 0.32 0.35	2791 grams/gallon

Label	T15				
Tare	227.5		Fuel Densi	ity	2804 grams/gallon
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Day	Wi grams	•	Change	Permeation	
D1	653.59	653.37	0.22	1.45	
D2	653.37	653.11	0.26	1.71	
D3	653.11	652.85	0.26	1.71	
D4	652.85	652.62	0.23	1.52	
D5	652.62	652.34	0.28	1.85	
D6	652.34	652.07	0.27	1.78	
D7	652.07	651.78	0.29	1.92	
D8	651.78	651.50	0.28	1.85	
D9	651.50	651.20	0.30	1.98	
			Avg.	1.88	
Label	T24A				
Label Tare	T24A 659.20		Fuel Densi	ity	2791 grams/gallon
			Fuel Densi	ity	2791 grams/gallon
	659.20	Wf grams	Fuel Densi Change	ity Permeation	2791 grams/gallon
Tare	659.20	•		•	2791 grams/gallon
Tare Day	659.20 Wi grams	1322.35	Change	Permeation	2791 grams/gallon
Tare Day D1	659.20 Wi grams 1323.62	1322.35 1321.07	Change 1.27	Permeation 5.33	2791 grams/gallon
Tare Day D1 D2	659.20 Wi grams 1323.62 1322.35	1322.35 1321.07 1319.84	Change 1.27 1.28	Permeation 5.33 5.39	2791 grams/gallon
Tare Day D1 D2 D3	659.20 Wi grams 1323.62 1322.35 1321.07	1322.35 1321.07 1319.84 1318.54	Change 1.27 1.28 1.23	Permeation 5.33 5.39 5.19	2791 grams/gallon
Day D1 D2 D3 D4	659.20 Wi grams 1323.62 1322.35 1321.07 1319.84	1322.35 1321.07 1319.84 1318.54 1317.24	Change 1.27 1.28 1.23 1.30	Permeation 5.33 5.39 5.19 5.49	2791 grams/gallon
Day D1 D2 D3 D4 D5	659.20 Wi grams 1323.62 1322.35 1321.07 1319.84 1318.54	1322.35 1321.07 1319.84 1318.54 1317.24 1315.93	Change 1.27 1.28 1.23 1.30 1.30	Permeation 5.33 5.39 5.19 5.49 5.50	2791 grams/gallon
Day D1 D2 D3 D4 D5 D6	659.20 Wi grams 1323.62 1322.35 1321.07 1319.84 1318.54 1317.24	1322.35 1321.07 1319.84 1318.54 1317.24 1315.93 1314.62	Change 1.27 1.28 1.23 1.30 1.30	Permeation 5.33 5.39 5.19 5.49 5.50 5.56	2791 grams/gallon
Day D1 D2 D3 D4 D5 D6 D7	659.20 Wi grams 1323.62 1322.35 1321.07 1319.84 1318.54 1317.24 1315.93	1322.35 1321.07 1319.84 1318.54 1317.24 1315.93 1314.62	Change 1.27 1.28 1.23 1.30 1.30 1.31 1.31	Permeation 5.33 5.39 5.19 5.49 5.50 5.56 5.57	2791 grams/gallon
Day D1 D2 D3 D4 D5 D6 D7 D8	659.20 Wi grams 1323.62 1322.35 1321.07 1319.84 1318.54 1317.24 1315.93 1314.62	1322.35 1321.07 1319.84 1318.54 1317.24 1315.93 1314.62 1313.31	Change 1.27 1.28 1.23 1.30 1.30 1.31 1.31	Permeation 5.33 5.39 5.19 5.49 5.50 5.56 5.57 5.58	2791 grams/gallon

Label	T24B				
Tare	660.85		Fuel Densi	ty	2791 grams/gallon
Day	Wi grams	Wf grams	Change	Permeation	
D1	1364.64	1363.41	1.23	4.88	
D2	1363.41	1362.12	1.29	5.12	
D3	1362.12	1360.84	1.28	5.09	
D4	1360.84	1359.55	1.29	5.14	_
D5	1359.55	1358.27	1.28	5.11	
D6	1358.27	1356.97	1.30	5.20	
D7	1356.97	1355.67	1.30	5.21	
D8	1355.67	1354.38	1.29	5.18	
D9	1354.38	1353.10	1.28	5.15	
			Avg.	5.17	
Label	T26				
Label Tare	T26 219.59		Fuel Densi	ty	2804 grams/gallon
	219.59			•	2804 grams/gallon
Tare Day	219.59 Wi grams	-	Change	ty Permeation	2804 grams/gallon
Tare Day D1	219.59 Wi grams 557.15	556.78	Change 0.37	Permeation 3.07	2804 grams/gallon
Tare Day D1 D2	219.59 Wi grams	-	Change	Permeation	2804 grams/gallon
Day D1 D2 D3	219.59 Wi grams 557.15	556.78	Change 0.37	Permeation 3.07	2804 grams/gallon
Tare Day D1 D2	219.59 Wi grams 557.15 556.78	556.78 556.43	Change 0.37 0.35	Permeation 3.07 2.91	2804 grams/gallon
Day D1 D2 D3	219.59 Wi grams 557.15 556.78 556.43	556.78 556.43 556.08	Change 0.37 0.35 0.35	Permeation 3.07 2.91 2.91	2804 grams/gallon
Day D1 D2 D3 D4	219.59 Wi grams 557.15 556.78 556.43 556.08	556.78 556.43 556.08 555.74	Change 0.37 0.35 0.35 0.34	Permeation 3.07 2.91 2.91 2.83	2804 grams/gallon
Day D1 D2 D3 D4 D5	219.59 Wi grams 557.15 556.78 556.43 556.08 555.74	556.78 556.43 556.08 555.74 555.37	Change 0.37 0.35 0.35 0.34 0.37	Permeation 3.07 2.91 2.91 2.83 3.09	2804 grams/gallon
Day D1 D2 D3 D4 D5 D6	219.59 Wi grams 557.15 556.78 556.43 556.08 555.74 555.37	556.78 556.43 556.08 555.74 555.37 555.00	Change 0.37 0.35 0.35 0.34 0.37	Permeation 3.07 2.91 2.91 2.83 3.09 3.09	2804 grams/gallon
Day D1 D2 D3 D4 D5 D6 D7	219.59 Wi grams 557.15 556.78 556.43 556.08 555.74 555.37 555.00	556.78 556.43 556.08 555.74 555.37 555.00 554.63	Change 0.37 0.35 0.35 0.34 0.37 0.37	Permeation 3.07 2.91 2.91 2.83 3.09 3.09 3.09	2804 grams/gallon

Label	T33				
Tare	211.14		Fuel Densi	ty	2804 grams/gallon
_				_	
Day	Wi grams	•	Change	Permeation	
D1	503.05	502.81	0.24	2.31	
D2	502.81	502.57	0.24	2.31	
D3	502.57	502.32	0.25	2.41	
D4	502.32	502.06	0.26	2.50	_
D5	502.06	501.77	0.29	2.80	
D6	501.77	501.50	0.27	2.60	
D7	501.50	501.20	0.30	2.90	
D8	501.20	500.94	0.26	2.51	
D9	500.94	500.64	0.30	2.90	
			Avg.	2.74	
Label	T34				
Label Tare	T34 168.19		Fuel Densi	ty	2804 grams/gallon
			Fuel Densi	ty	2804 grams/gallon
			Fuel Densi Change	ty Permeation	2804 grams/gallon
Tare	168.19			•	2804 grams/gallon
Tare Day	168.19 Wi grams	Wf grams	Change	Permeation	2804 grams/gallon
Tare Day D1	168.19 Wi grams 406.11	Wf grams 405.90	Change 0.21	Permeation 2.47	2804 grams/gallon
Tare Day D1 D2	168.19 Wi grams 406.11 405.90	Wf grams 405.90 405.69	Change 0.21 0.21	Permeation 2.47 2.48	2804 grams/gallon
Tare Day D1 D2 D3	168.19 Wi grams 406.11 405.90 405.69	Wf grams 405.90 405.69 405.47	Change 0.21 0.21 0.22	Permeation 2.47 2.48 2.60	2804 grams/gallon
Day D1 D2 D3 D4	168.19 Wi grams 406.11 405.90 405.69 405.47	Wf grams 405.90 405.69 405.47 405.25	Change 0.21 0.21 0.22 0.22	Permeation 2.47 2.48 2.60 2.60	2804 grams/gallon
Day D1 D2 D3 D4 D5	168.19 Wi grams 406.11 405.90 405.69 405.47 405.25	Wf grams 405.90 405.69 405.47 405.25 405.01	Change 0.21 0.21 0.22 0.22 0.24	Permeation 2.47 2.48 2.60 2.60 2.84	2804 grams/gallon
Day D1 D2 D3 D4 D5 D6	168.19 Wi grams 406.11 405.90 405.69 405.47 405.25 405.01	Wf grams 405.90 405.69 405.47 405.25 405.01 404.77	Change 0.21 0.21 0.22 0.22 0.24 0.24	Permeation 2.47 2.48 2.60 2.60 2.84 2.84	2804 grams/gallon
Day D1 D2 D3 D4 D5 D6 D7	168.19 Wi grams 406.11 405.90 405.69 405.47 405.25 405.01 404.77	Wf grams 405.90 405.69 405.47 405.25 405.01 404.77 404.52	Change 0.21 0.21 0.22 0.22 0.24 0.24 0.25	Permeation 2.47 2.48 2.60 2.60 2.84 2.84 2.96	2804 grams/gallon
Day D1 D2 D3 D4 D5 D6 D7 D8	168.19 Wi grams 406.11 405.90 405.69 405.47 405.25 405.01 404.77 404.52	Wf grams 405.90 405.69 405.47 405.25 405.01 404.77 404.52 404.28 404.01	Change 0.21 0.21 0.22 0.22 0.24 0.24 0.25 0.24	Permeation 2.47 2.48 2.60 2.60 2.84 2.84 2.96 2.85	2804 grams/gallon

Label	T35				
Tare	218.25		Fuel Densi	ty	2804 grams/gallon
_					
Day	Wi grams	•	Change	Permeation	
D1	475.79	475.66	0.13	1.42	
D2	475.66	475.49	0.17	1.85	
D3	475.49	475.31	0.18	1.96	
D4	475.31	475.15	0.16	1.75	
D5	475.15	474.98	0.17	1.86	
D6	474.98	474.79	0.19	2.08	
D7	474.79	474.61	0.18	1.97	
D8	474.61	474.40	0.21	2.30	
D9	474.40	474.20	0.20	2.19	
			Avg.	2.08	
Label	T36				
Label Tare	T36 168.63		Fuel Densi	ity	2804 grams/gallon
			Fuel Densi	ity	2804 grams/gallon
		Wf grams	Fuel Densi Change	ity Permeation	2804 grams/gallon
Tare	168.63	Wf grams 364.13		•	2804 grams/gallon
Tare Day	168.63 Wi grams	364.13	Change	Permeation	2804 grams/gallon
Tare Day D1	168.63 Wi grams 364.33	364.13	Change 0.20	Permeation 2.87	2804 grams/gallon
Tare Day D1 D2	168.63 Wi grams 364.33 364.13	364.13 363.95	Change 0.20 0.18	Permeation 2.87 2.58	2804 grams/gallon
Tare Day D1 D2 D3	168.63 Wi grams 364.33 364.13 363.95	364.13 363.95 363.75	Change 0.20 0.18 0.20	Permeation 2.87 2.58 2.87	2804 grams/gallon
Day D1 D2 D3 D4	168.63 Wi grams 364.33 364.13 363.95 363.75	364.13 363.95 363.75 363.56	Change 0.20 0.18 0.20 0.19	Permeation 2.87 2.58 2.87 2.73	2804 grams/gallon
Day D1 D2 D3 D4 D5	168.63 Wi grams 364.33 364.13 363.95 363.75 363.56	364.13 363.95 363.75 363.56 363.35	Change 0.20 0.18 0.20 0.19 0.21	Permeation 2.87 2.58 2.87 2.73 3.02	2804 grams/gallon
Day D1 D2 D3 D4 D5 D6	168.63 Wi grams 364.33 364.13 363.95 363.75 363.56 363.35	364.13 363.95 363.75 363.56 363.35 363.14	Change 0.20 0.18 0.20 0.19 0.21 0.21	Permeation 2.87 2.58 2.87 2.73 3.02 3.02	2804 grams/gallon
Day D1 D2 D3 D4 D5 D6 D7	168.63 Wi grams 364.33 364.13 363.95 363.75 363.56 363.35 363.14	364.13 363.95 363.75 363.56 363.35 363.14 362.95	Change 0.20 0.18 0.20 0.19 0.21 0.21 0.19	Permeation 2.87 2.58 2.87 2.73 3.02 3.02 2.74 3.03	2804 grams/gallon
Day D1 D2 D3 D4 D5 D6 D7 D8	168.63 Wi grams 364.33 364.13 363.95 363.75 363.56 363.35 363.14 362.95	364.13 363.95 363.75 363.56 363.35 363.14 362.95 362.74	Change 0.20 0.18 0.20 0.19 0.21 0.21 0.19 0.21	Permeation 2.87 2.58 2.87 2.73 3.02 3.02 2.74	2804 grams/gallon

Label	T40		Fuel Densi	4	2701 grama/gallan
Tare	294.91		Fuel Densi	ty	2791 grams/gallon
Day	Wi grams	Wf grams	Change	Permeation	
D1	977.17	976.59	0.58	2.37	
D2	976.59	976.00	0.59	2.42	
D3	976.00	975.39	0.61	2.50	
D4	975.39	974.74	0.65	2.67	
D5	974.74	974.06	0.68	2.79	
D6	974.06	973.42	0.64	2.63	
D7	973.42	972.74	0.68	2.80	
D8	972.74	972.09	0.65	2.68	
D9	972.09	971.41	0.68	2.80	
			Avg.	2.74	
Label	T41				
Label Tare	T41 427.99		Fuel Densi	ty	2791 grams/gallon
Tare	427.99	VA/#		•	2791 grams/gallon
Tare Day	427.99 Wi grams	_	Change	Permeation	2791 grams/gallon
Tare Day D1	427.99 Wi grams 1177.01	1176.00	Change 1.01	Permeation 3.76	2791 grams/gallon
Tare Day D1 D2	427.99 Wi grams 1177.01 1176.00	1176.00 1174.97	Change 1.01 1.03	Permeation 3.76 3.84	2791 grams/gallon
Tare Day D1 D2 D3	427.99 Wi grams 1177.01 1176.00 1174.97	1176.00 1174.97 1173.95	Change 1.01 1.03 1.02	Permeation 3.76 3.84 3.81	2791 grams/gallon
Day D1 D2 D3 D4	427.99 Wi grams 1177.01 1176.00 1174.97 1173.95	1176.00 1174.97 1173.95 1172.89	Change 1.01 1.03 1.02 1.06	Permeation 3.76 3.84 3.81 3.97	2791 grams/gallon
Day D1 D2 D3 D4 D5	427.99 Wi grams 1177.01 1176.00 1174.97 1173.95 1172.89	1176.00 1174.97 1173.95 1172.89 1171.78	Change 1.01 1.03 1.02 1.06	Permeation 3.76 3.84 3.81 3.97 4.16	2791 grams/gallon
Day D1 D2 D3 D4 D5 D6	427.99 Wi grams 1177.01 1176.00 1174.97 1173.95 1172.89 1171.78	1176.00 1174.97 1173.95 1172.89 1171.78 1170.71	Change 1.01 1.03 1.02 1.06 1.11 1.07	Permeation 3.76 3.84 3.81 3.97 4.16 4.02	2791 grams/gallon
Day D1 D2 D3 D4 D5 D6 D7	427.99 Wi grams 1177.01 1176.00 1174.97 1173.95 1172.89 1171.78 1170.71	1176.00 1174.97 1173.95 1172.89 1171.78 1170.71 1169.63	Change 1.01 1.03 1.02 1.06 1.11 1.07 1.08	Permeation 3.76 3.84 3.81 3.97 4.16 4.02 4.06	2791 grams/gallon
Day D1 D2 D3 D4 D5 D6 D7 D8	427.99 Wi grams 1177.01 1176.00 1174.97 1173.95 1172.89 1171.78 1170.71 1169.63	1176.00 1174.97 1173.95 1172.89 1171.78 1170.71 1169.63 1168.52	Change 1.01 1.03 1.02 1.06 1.11 1.07 1.08 1.11	Permeation 3.76 3.84 3.81 3.97 4.16 4.02 4.06 4.18	2791 grams/gallon
Day D1 D2 D3 D4 D5 D6 D7	427.99 Wi grams 1177.01 1176.00 1174.97 1173.95 1172.89 1171.78 1170.71	1176.00 1174.97 1173.95 1172.89 1171.78 1170.71 1169.63	Change 1.01 1.03 1.02 1.06 1.11 1.07 1.08	Permeation 3.76 3.84 3.81 3.97 4.16 4.02 4.06	2791 grams/gallon

Label Tare	T45 442.28		Fuel Densi	2804 grams/gallon	
				•	
Day	Wi grams	Wf grams	Change	Permeation	
D1	1140.64	1140.50	0.14	0.56	
D2	1140.50	1140.39	0.11	0.44	
D3	1140.39	1140.31	0.08	0.32	
D4	1140.31	1140.26	0.05	0.20	
D5	1140.26	1140.23	0.03	0.12	
D6	1140.23	1140.16	0.07	0.28	
D7	1140.16	1140.07	0.09	0.36	
D8	1140.07	1140.02	0.05	0.20	
D9	1140.02	1140.00	0.02	0.08	
			Avg.	0.21	